A Unified Finishing System for Guitar Family Instruments

Formulations, Preparatory Grounds, Shellac Blend, and Oil-Dominant Wiping Varnish

Author: Jeremy Clark – 52 Instrument Co. - Montréal (Québec) Canada

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1. Introduction

Over the last several years, I have spent considerable time experimenting with finishes: exploring materials, developing formulations, refining application techniques, and working out how individual components interact. The results have accumulated across shop notes, experiments, and social media posts. This document brings them together in one place, covering the materials, formulations, procedures, and reasoning behind my current approach to finishing guitar-family instruments.

The emphasis is on practical application, with enough explanation of the chemistry and material behaviour to make the choices understandable rather than simply prescriptive. The goal is to share what I have learned and to give other makers enough information to evaluate, reproduce, adapt, and improve upon this work.

The central premise is that a finish should be treated as a system rather than a collection of independent materials. Each ingredient matters, but so does its interaction with the wood, its relationship to the layers above and below it, how much of it is left on the surface, and how it behaves during application and over time.

On a musical instrument, acoustic performance and conventional finish performance cannot be separated. A finish must look good, protect the wood, wear well, feel right in the hand, and remain repairable, while adding as little unwanted mass, stiffness, and damping as possible. These goals are not necessarily in conflict, but meeting them together means thinking about the whole finish rather than any single layer. No single property is the sole target; the balance between them depends on the instrument, its intended use, and the maker's priorities.

What follows is my current practice, developed through experimentation and observation. It is not offered as a universal prescription, and I do not claim that every proposed mechanism is fully understood. Where possible, I distinguish established material properties from observations in my own work and from working hypotheses.

1.1 The System at a Glance

Layer / Component	Material	Role	Where it is Used
Casein Sealer	Casein, borax, and water or ethanol	Prepares and consolidates the near-surface wood structure; moderates subsequent penetration	Every surface, as the first finish treatment
Pore Filler	Dry pumice and shellac blend, activated with alcohol	Levels open pores with minimal added material	Open-pored woods, as needed
Glyceryl Rosinate Ground	Rosin ester in terpene solvents, with a little linseed oil	Optical depth and a thin mechanical foundation	Under shellac only
Shellac	Dewaxed shellac, sandarac, and mastic in ethanol	Thin, clear, glossy, repairable surface	Over the ground
Rosinate Anchor Oil (RAO)	Rosin ester, polymerized tung oil, and wax	Tougher, thin, repairable oil-based surface	Directly on the casein-sealed surface; backs, sides, and necks

The typical application paths depend on the component being treated. Soundboards follow a sequence of casein sealer, glyceryl rosinate ground, and shellac. Backs and sides receive casein sealer and pore filler if open-pored, followed either by Rosinate Anchor Oil or by the ground and then shellac. Necks receive casein sealer, pore filler as required, and Rosinate Anchor Oil.

1.2 Key Materials

The system relies on technical-grade acid casein (CAS 9000-71-9) as the foundational protein sealer. The optical ground uses a pale grade glycerol ester of rosin, known as glyceryl rosinate (CAS 8050-31-5), with an acid value of 10 mg KOH/g or less. Film formation in French polishing relies on dewaxed shellac modified with sandarac and mastic resins dissolved in ethanol containing at least 95% ethanol, preferring grades denatured without methanol to minimize toxic shop exposure.

Solvents and oil vehicles include pure gum turpentine (CAS 8006-64-2) and citrus-derived d-limonene (CAS 5989-27-5) to carry terpene-soluble resins. The wiping varnish uses a commercial polymerized tung oil composed of roughly 50% polymerized oil and 50% mineral spirits, alongside hydrotreated mineral spirits (CAS 64742-48-9) added separately as a viscosity modifier. Natural candelilla wax and yellow beeswax are incorporated in minor amounts to temper surface sheen and refine tactile feedback on wiped oil coats.

2. Casein: Protein-Based Surface Consolidation

2.1 Purpose and Rationale: Why Casein Over Other Proteins?

In historical finishing and modern wood conservation, several protein-based binders are available—most notably animal hide glue/gelatin (collagen), egg albumin, and soy protein. Selecting casein over these alternative protein sources is a deliberate choice driven by its unique chemical stability, moisture resistance, and mechanical behaviour once dry.

Unlike collagen-based glues and egg albumin, which remain strongly hydrophilic and water-soluble after drying, casein cures into a hydrophobic, solvent-insoluble barrier. Animal hide glues and un-heated egg albumin re-absorb atmospheric moisture, softening under high humidity and swelling wood fibres long after application. Casein, once dried from an alkaline dispersion, undergoes structural realignment. It becomes permanently water-resistant and is completely insoluble in both ethanol and terpene solvents. It will not re-soften, drag, or dissolve when subsequent pore fillers, optical grounds, spirit varnishes, or oil coats are padded or wiped over top. Furthermore, unlike soy proteins—which contain non-functional oils and carbohydrates that interfere with the curing of subsequent finishes—technical-grade acid casein provides a pure, concentrated protein matrix.

In this finishing system, casein serves as the foundational treatment applied directly to bare wood across every surface. Its purpose is to prepare and consolidate the near-surface wood structure, binding loose micro-fibrils while moderating the absorption of subsequent layers. It is applied sparingly and wiped back immediately. The objective is not to build a distinct surface film, but to leave as little material on the surface as practical, embedding the protein strictly within the uppermost cellular cavities. Because cured casein is insoluble in ethanol and terpene solvents, it forms an immovable physical barrier that remains completely stable during subsequent French polishing or oil application.

2.2 Water-Based Casein

Component	Concentration	Proportional Parts	200 g Batch	Function & Physical Role
Casein powder	1.5%	100.0	3.0 g	Technical-grade acid casein; primary protein consolidator for upper cell wall fibers.
Borax	0.3%	20.0	0.6 g	Alkaline dispersant; raises pH to hydrate casein into a concentrated paste before ethanol addition
Water	98.2%	6,546.7	196.4 g	Primary liquid carrier vehicle.
Total	**100%**	**6,666.7**	**200.0 g**	Apply sparingly to bare wood and wipe back immediately.

Chemical Mechanism:

Raw acid casein is insoluble in neutral water. Adding borax (sodium tetraborate decahydrate) raises the pH of the solution. As the pH rises into the alkaline range, acidic carboxyl groups on the casein

polypeptide chains lose protons and acquire a negative charge. The resulting electrostatic repulsion causes the tightly folded protein structures to uncoil, hydrate, and disperse uniformly in water. The resulting mixture is best described as an alkaline casein dispersion rather than a strictly stoichiometric sodium caseinate solution.

Preparation and Application Rationale:

Dissolve the borax completely in the water, add the casein powder, and allow it to hydrate until the mixture is smooth and uniform. This formulation does not normally require stirring before subsequent uses. Apply sparingly to bare wood and wipe off the excess immediately. Avoid aggressive rubbing during wipe-back, which can tear the wet fibres or cause uneven redistribution of the protein mass. Allow the surface to dry completely before proceeding. Because this formulation contains no volatile preservatives, prepare it in small batches, store it in a sealed container under refrigeration, and use or discard it within roughly one week.

While water-based casein provides exceptional fibre binding, applying water to bare wood introduces a well-understood physical trade-off: water molecules break internal hydrogen bonds in wood cellulose, causing cell walls to swell and raising the grain. This requires a light surface defuzzing or careful timing in the finishing schedule.

2.3 Alcohol-Based Casein

The alcohol-based formulation maintains the same 1.5% casein concentration as the water-based version but uses ethanol as the primary liquid carrier. Its main purpose is to consolidate and stiffen surface fibres with minimal water introduction, drying rapidly to make it highly useful before moisture-sensitive operations—such as routing rosette and binding channels—where water-induced grain swelling would compromise joint tolerances.

Component	Concentration	Proportional Parts	200 g Batch	Function & Physical Role
Casein powder	1.5%	100.0	3.0 g	Technical-grade acid casein; primary protein consolidator for upper cell wall fibers.
Borax	0.3%	20.0	0.6 g	Alkaline dispersant; raises pH to hydrate casein into a concentrated paste before ethanol addition
Water	15.0%	1,000.0	30.0 g	Essential hydration shell; maintains protein suspension in high-alcohol carrier
Ethanol	83.2%	5,546.7	166.4 g	Fast-evaporating volatile carrier; minimizes water contact to prevent grain raising.
Total	**100%**	**6,666.7**	**200.0 g**	Ethanol-rich colloidal dispersion. Shake or stir thoroughly before use.

Preparation and Solubility Rationale:

Dissolve the borax in the minimal water portion first, add the casein powder, and allow it to hydrate completely into a concentrated alkaline paste. Only after full hydration should the ethanol be introduced gradually while mixing continuously—using a high-shear mixer at this stage is exceptionally helpful to maintain suspension.

Because casein is completely insoluble in pure ethanol, this formulation is an ethanol-rich colloidal dispersion rather than a true solution. The small water fraction provides the necessary hydration shell for the proteins, while the overwhelming ethanol volume acts as a fast-evaporating carrier. Adding alcohol too rapidly or omitting the initial water-hydration step causes the proteins to immediately aggregate and crash out of suspension. Minor settling over time is normal; shake or stir thoroughly before use. In shop practice, batches remain usable for several months.

> ▲ **Safety Warning:** Ethanol and its concentrated vapours are highly flammable and act as an eye and respiratory irritant. Ensure adequate ventilation, keep containers tightly closed when not in use, use appropriate skin and eye protection, and eliminate all potential ignition sources.

3. Pore Filling: A Dry Pumice and Shellac Composite

3.1 Purpose and Rationale: Mechanics of Pore Filling

The objective of pore filling is to bring open wood pores level with the surrounding surface while adding as little unnecessary mass, bulk material, and internal damping to the finish system as possible. Open-pored tonewoods—such as rosewood, mahogany, and walnut—present thousands of microscopic surface voids that must be bridged before a flat, high-gloss surface can be established.

Traditional pore-filling methods generally fall into two categories: liquid pastes formulated with drying oils and mineral fillers, or conventional wet-pumice French polishing slurries. Both approaches introduce distinct mechanical limitations on an acoustic instrument. Commercial oil-based pastes rely on alkyd or linoxyn binders that remain soft for long periods, yellow over time, and add significant damping mass inside the cellular structure of the wood. Wet-pumice slurries, on the other hand, rely on liquid shellac dissolved in ethanol to transport pumice particles into the pores. As the high solvent volume evaporates from within the pore cavity, the wet mixture experiences substantial volume loss, causing the filled pores to sink and hollow out weeks or months after the finish is completed.

This system solves those limitations by treating pore filling as an engineering problem in composite materials rather than a wet painting step. Dry pumice acts as the inorganic aggregate, ground shellac acts as the thermoplastic binder, and alcohol serves purely as a temporary, in-situ chemical activator. By mechanically dry-packing the pores with the aggregate and solid binder *before* introducing alcohol, the solid volume inside the pore is established prior to solvent arrival. Evaporative shrinkage is dramatically reduced, eliminating the primary cause of pore sinking.

3.2 Formulation and Sieve Calibration

Component	Concentration	Proportional Parts	50 g Batch	Function & Physical Role
FFFF pumice	74.89%	100	37.45 g	Inorganic aggregate; inert, low-density void filler with high clarity.
Finely ground dewaxed shellac	24.96%	33.3	12.5 g	Thermoplastic binder; locks aggregate upon solvent activation.
Ivory black pigment	0.15%	0.2	0.08 g	Tone-matching modifier; prevents ashiness in dark hardwoods.
Total	**100%**	**133.53**	**50.00 g**	Activate on-surface using pure 95%+ ethanol.

Note: The ivory black can be adjusted or substituted with earth pigments (such as raw umber or burnt sienna) to match specific warm-toned wood species.

Sieving and Particle Packing Rationale:

Before combining, the FFFF pumice and ground dewaxed shellac must be sieved separately through a 100-mesh screen. For the shellac, this step removes un-ground flakes and oversized particles that would otherwise bridge over pore openings rather than settling cleanly into them. For the pumice, while industrial FFFF grade is inherently finer than a 100-mesh layout, sieving breaks up compacted clumps and strains out any stray workshop contaminants. Achieving this uniform particle size distribution is essential for close-packed aggregate geometry, allowing the dry powder to flow effortlessly into narrow pore cavities under light mechanical pressure.

Binder Ratio Rationale:

The 3:1 pumice-to-shellac ratio was derived through practical shop trials. If the binder concentration drops below this threshold, the cured fill lacks sufficient internal cohesion and may crumble out during subsequent flat-sanding. Conversely, increasing the shellac ratio beyond 3:1 introduces excess resin mass into the pore void, increasing overall film weight and re-introducing potential solvent-evaporation shrinkage.

3.3 Application Protocol

Before filling, the bare wood surface is sanded clean to 220 grit, sealed with casein as outlined in Section 2, wiped back completely, and allowed to cure. Casein sealing is a mandatory prerequisite; it prevents loose dry pigment and pumice from embedding directly into the bare wood fibres outside the pores, preserving crisp visual contrast between dark pore lines and clear wood tissue.

The dry pumice-shellac mixture is worked firmly into the open pores using a dedicated, dry cotton ball, moving in tight circular patterns over small sections. Once a section's pores are fully packed with dry powder, a second, separate cotton ball lightly dampened with 95%+ ethanol is passed over the area. The alcohol immediately dissolves the solid shellac particles in situ, causing the binder to flow around the adjacent pumice grains and lock them into a solid matrix.

Once the alcohol has evaporated and the activated composite has set, the surface is dry-sanded level using fresh 320-grit paper, shearing away all excess surface material while leaving the pore cavities perfectly flush. Deeply porous woods may require a second application pass.

3.4 Observed Bench Results

Using a dry-packed composite method yields several distinct shop advantages over wet slurry padding. Because the binder activation occurs instantly on the surface, drying times between filling and flat-sanding are reduced from days to hours. The cured pumice-shellac composite abrades cleanly without clogging paper, and because shellac is the sole binding resin, the filled pores remain completely compatible with both subsequent spirit varnish padding and oil-dominant wiping systems. Most important, instruments finished using this technique demonstrate better long-term surface stability, showing significantly less pore telegraphing or post-cure sinking over seasonal environmental cycles.

4. Glyceryl Rosinate Ground

4.1 Purpose and Rationale: A Distinct Mechanical and Optical Layer

Applied directly over the casein sealer and beneath the final shellac coats, the glyceryl rosinate ground establishes both the optical foundation and the mechanical substrate of the finish. This allows subsequent shellac layers to serve a single, focused purpose: building a thin, clear, glossy, and easily repairable protective surface.

This formulation grows out of an interest in how finishing materials contribute to the mechanical system of the instrument, particularly on the soundboard. Because a finish becomes an intrinsic part of the top plate, its mass, stiffness, and internal damping directly influence how the wood behaves. The goal is to achieve surface protection and visual depth while minimizing unwanted damping mass. In measurements on treated wood specimens, combining the casein sealer with the glyceryl rosinate ground produced a higher radiation ratio—the speed of sound in the material relative to its density—alongside lower acoustic damping. While these specimen results describe tested wood under specific experimental conditions, they highlight how an ultra-thin resin treatment can alter surface properties without loading the plate down with mass.

Optically, the ground produces a pronounced enhancement of the wood's natural figure, giving the grain visual activity and chatoyancy that shellac alone cannot match. This visual depth is driven by the high refractive index of glyceryl rosinate (≈1.54), which closely matches the refractive index of crystalline cellulose and lignin within the wood cell walls (≈1.53-1.58). By minimizing light scattering at the wood-finish boundary, light penetrates deeper into the cellular structure before reflecting back to the viewer, creating a dynamic, three-dimensional quality that appears lit from within.

Practically, glyceryl rosinate is completely insoluble in ethanol. Once cured, it will not redissolve under normal shellac application, making the base layer resilient against disturbance from an overly wet polishing pad. As a result, significantly less shellac is needed to achieve a flat, high-gloss finish.

4.2 The Resin: Glyceryl Rosinate

Glyceryl rosinate—also known as glycerol ester of rosin or ester gum—is produced by esterifying the natural resin acids in pine rosin with glycerol. Raw pine rosin consists primarily of abietic acid, which is

highly acidic, brittle, chemically unstable, and prone to oxidation over time. Esterifying rosin with glycerol neutralizes these carboxyl groups, yielding a resin that is substantially less acidic, chemically stable, and higher in softening point.

While commercial grades of ester gum vary widely in colour, acid value, and purity based on industrial intended use, I specify a pale grade with an acid value of 10 mg KOH/g or less. This specific grade is selected strictly for its optical clarity, chemical neutrality, and favourable mechanical footprint on tone wood.

4.3 Solvent System and Evaporation Control

The liquid carrier is a blend of pure gum turpentine and d-limonene mixed in a 3:1 ratio by weight. Both are natural terpene solvents capable of fully dissolving the resin, but they evaporate at markedly different rates. Gum turpentine evaporates relatively quickly to drive initial surface wetting and even distribution across the wood tissue. Citrus-derived d-limonene evaporates much more slowly, extending the active open time and easing wipe-back.

This 3:1 solvent blend is formulated mostly of volatile carrier by design. The material is intended to be applied thinly and wiped back aggressively rather than built up into a conventional varnish film. The volume of solid resin left on the wood matters far more than the concentration inside the container.

4.4 Formulation

Component	Concentration	Proportional Parts	227 g Batch	Function & Physical Role
Glyceryl rosinate	11.0%	100	25.0 g	Primary structural resin; establishes optical depth and alcohol-insoluble ground.
Gum turpentine	66.1%	600	150.0 g	Fast-evaporating terpene solvent; drives wetting and initial film distribution.
d-Limonene	22.0%	200	50.0 g	Slow-evaporating terpene solvent; extends working window and wipe-back open time.
Art-grade sun-bleached linseed oil	0.9%	8	2.0 g	Plasticizer; imparts film flexibility to prevent long-term brittleness.
Total	**100.00%**	**908**	**227 g**	Apply sparingly and wipe back aggressively.

Note: The small addition of linseed oil provides the ground with the limited flexibility required to accommodate seasonal wood movement without checking. It is vital to use refined, sun-bleached art-grade oil, as raw or hardware-store linseed oils contain impurities and drying metal additives that alter cure rate and clarity.

4.5 Preparation and Application Protocol

Preparation requires no applied heat. The solid glyceryl rosinate is crushed or ground to increase surface area, then dissolved directly into the mixed turpentine and d-limonene at room temperature (leaving the mixture overnight is sufficient). Once dissolved, the linseed oil is stirred in until the solution is completely homogeneous. The finished mixture is stored in a tightly closed container inside a flammable-liquid safety cabinet and swirled briefly before use to ensure absolute homogeneity.

Apply the ground sparingly to the prepared wood using a clean cloth pad and wipe it off immediately. The objective is an ultra-thin, even boundary treatment rather than a visibly built-up coating.

On soundboards, do not abrade or sand the surface between the casein treatment and the glyceryl rosinate ground. Because both preparatory treatments are applied thinly and aggressively wiped back, avoiding sanding preserves the continuous physical boundary layer rather than mechanically interrupting it. Allow the ground to dry completely before proceeding with shellac, noting that exact dry times depend on shop humidity, temperature, and how thoroughly excess resin was removed.

5. Shellac: Formulation and Preparation

5.1 Formulation and Rationale: The Resin Matrix

The spirit varnish blend combines dewaxed shellac, sandarac, mastic, and spike lavender oil into a precise, highly modified alcohol solution.

Component	Concentration	Proportional Parts	250 g Batch	Function & Mechanical Role
Dewaxed shellac	10.3%	87.0	25.8 g	Principal film-forming resin; provides elasticity, toughness, and chemical reversibility.
Sandarac	1.2%	10.0	3.0 g	Hard resin modifier; significantly increases surface hardness, scratch resistance, and gloss clarity.
Mastic	0.4%	3.0	0.9 g	Soft resin plasticizer; counters sandarac's inherent brittleness, improves adhesion, and refines padding flow.
Spike lavender oil	0.14%	1.2	0.36 g	Solvent retarding agent; keeps top micro-layer open for flow and bubble release. Add post-thermal cycles.
Ethanol (95%+)	88.0%	742.1	220.0 g	Primary volatile carrier vehicle.
Total	**100%**	**843.3**	**250.0 g**	Execute three-cycle thermal processing routine after filtering.

Why Modify Straight Shellac?

While straight shellac is the historic standard for French polishing, it presents practical limitations on a working instrument: it can be relatively soft under fingernails, prone to pressure marking from instrument cases or clothing, and sensitive to moisture. We modify it because no single natural resin possesses an ideal balance of hardness, flexibility, and repairability.

Sandarac is incorporated because it forms an exceptionally hard, glass-like film with brilliant clarity and superior wear resistance. However, raw sandarac is notoriously brittle; if used in high concentrations, the film will eventually craze, check, or shatter under seasonal wood movement and physical shock. To solve this, mastic is introduced in a minor proportion to act as an internal plasticizer. Mastic is a softer, highly flexible terpene resin that interlocks with the harder matrix, relieving internal stresses and preventing the sandarac from checking, while simultaneously improving pad flow and adhesion. The 87:10:3 resin solids ratio is an empirically optimized balance: it introduces just enough sandarac to maximize surface hardness and gloss, tempered by precisely enough mastic to maintain film stability, leaving the dominant shellac matrix to preserve overall cohesion, repairability, and acoustic compliance.

The Functional Necessity of Spike Lavender Oil

Spike lavender oil—distilled from *Lavandula latifolia*—is a natural terpene solvent with a significantly lower evaporation rate than ethanol. In French polishing, ethanol evaporates almost instantly upon leaving the pad, which can cause the outer surface of the applied resin film to skin over prematurely. Spike lavender oil acts as a powerful solvent retarding agent and levelling modifier. Because it remains in the film slightly longer than the ethanol, it keeps the top micro-layer open just long enough for the padding motion to smooth out ridges, pop entrained air bubbles, and coalesce into a perfectly flat, optical film. Furthermore, its solvent power helps blend each new pass seamlessly into the previous layer without tearing the underlying varnish.

5.2 Preparation, Boiling Nucleation, and Thermal Processing

Before dissolving, the raw sandarac and mastic tears are ground alongside the shellac flakes to increase surface area and ensure uniform distribution in solution. The solid resin mixture is dissolved in 95%+ ethanol to yield a stock solution containing exactly 12% total resin solids by weight, then passed through 10-micron filter paper to eliminate residual insoluble plant matter or mineral contaminants inherent to raw natural resins.

Once filtered, the varnish undergoes a three-cycle thermal processing routine using a flame-free electric heat source and a water bath. Before heating, a clean wooden stick or glass stirring rod must be placed directly into the liquid container. In a smooth, clean glass vessel, pure spirit solutions heated in a water bath can easily become superheated—reaching temperatures above their boiling point without actually boiling—due to a lack of nucleation sites. Introducing a textured wood stick or scratched glass rod provides the necessary physical surface points for controlled vapour bubble formation, preventing sudden, violent eruptive boiling.

The liquid is brought to a gentle boil in a vessel fitted with a loose cover to minimize solvent loss without creating pressure buildup. The solution is held at a soft boil for exactly five minutes, removed from the heat source, and allowed to cool completely back to room temperature. This heating and cooling loop is executed three times in total. After the final cycle has cooled, the container is weighed to quantify evaporated solvent, fresh ethanol is added to restore the original 12% resin concentration, and the spike lavender oil is stirred in until fully incorporated at a rate of 1.2% of total resin weight.

> ▲ **Safety Warning:** Ethanol vapours are highly flammable and explosive. Always execute thermal processing using a flame-free electric or induction water bath in a well-ventilated area. Never seal the boiling vessel tightly, as pressure buildup creates a severe explosion hazard.

5.3 Practical Effects of Thermal Processing

In shop practice, heat-treating the spirit varnish alters its bench behaviour in several noticeable ways: the processed varnish builds film thickness more efficiently during padding sessions, cures into a noticeably harder surface film, and abrades cleanly during final levelling without loading or gumming sandpaper.

While the exact molecular mechanisms underlying these improvements remain unverified in wood science literature, several working hypotheses help explain the observed changes. Thermal cycling may disrupt secondary hydrogen bonding networks between complex shellac constituent acids, allowing the resin macromolecules to pack more tightly upon solvent evaporation. Heat processing may also drive off trace volatile fractions inherent to fresh lac resins, promote minor ester interchange between resin acids, or improve the colloidal dispersion of the mastic and sandarac within the primary shellac phase. Regardless of the precise structural chemical driver, the three-cycle thermal process remains a cornerstone step in producing a spirit varnish with superior shop workability and film hardness.

6. Fad: Composition and Construction

6.1 The Fad as a Fluid-Control Tool

In French polishing, the polishing pad—traditionally referred to as a *fad*, *rubber*, *tampon* (in French), or *muñeca* (in Spanish)—is far more than a simple cloth applicator. It functions as a dynamic, hand-regulated fluid delivery pump and levelling tool. The mechanical success of the French polishing process depends entirely on precise control over solvent release, surface friction, and boundary lubrication.

If the pad releases spirit varnish too quickly, the liquid floods the surface, dragging the softer underlying layers and leaving pronounced ridges. Conversely, if it releases varnish too slowly, the pad dries out, drags, and tears the curing film. A well-constructed fad must reconcile two distinct physical requirements: an absorbent inner core that stores a varnish reservoir and releases it predictably under subtle variations in hand pressure, and a smooth outer cover that regulates fluid transfer, resists tearing over sharp wood edges, and eliminates fibre shedding.

6.2 Core Composition and Fibre Mechanics

The inner core of the pad is formed using approximately 5 grams of raw fibre mixed in a 50:50 blend of natural cotton and wool.

Component	Proportion	Physical Properties & Functional Role
Natural cotton	50%	Fine capillary network; high absorbency and gradual fluid release.
Natural wool	50%	Crimped fibre geometry; high elastic rebound and compression recovery.

The Rationale for a Blended Core

Pure cotton cores store an abundance of spirit varnish, but under continuous hand pressure, the cotton fibres quickly pack down into a dense, non-yielding wad. Once compressed, a pure cotton core loses its

elastic rebound and begins releasing liquid unpredictably, dumping solvent when squeezed and withholding it when relaxed. Pure wool cores retain their spring and structural rebound exceptionally well under repeated compression, but wool fibres lack the fine capillary network required to hold thin spirit cuts evenly, leading to sudden varnish pooling on the wood.

Comparative workshop trials across various fibre ratios demonstrated that a 50:50 blend provides the optimum mechanical balance. The dense cotton fibres create a stable, uniform fluid reservoir, while the natural crimp and structural resilience of the wool fibres keep the core springy and compliant under varying hand pressure. This compliance allows the maker to modulate fluid flow precisely by varying grip pressure while maintaining uniform contact across contoured surfaces.

6.3 Core Construction Protocol

To assemble the core, the cotton and wool fibres are combed and teased together thoroughly until the mixture is completely homogeneous, eliminating localized clumps of a single fibre type. The blended fibres are compressed by hand into a compact disc roughly 3.5 centimetres in diameter and 1.5 centimetres thick.

This disc is encased in a single layer of loose cheesecloth, which is gathered tightly at the top and secured. The cheesecloth serves purely as an internal structural restraint, holding the core's shape when the outer cover is removed for reloading or replacement. Before use, the core is tested by compressing it under finger pressure and releasing it; it should rebound instantly to its original volume. This elastic memory ensures the pad deforms smoothly over instrument contours without collapsing flat over time.

6.4 Cover Selection: Habotai Silk

The outer wrapper of the fad forms the direct physical interface with the curing finish. While traditional French polishing manuals often recommend un-dyed linen or fine cotton cloth, continuous-filament habotai silk provides significant practical and mechanical advantages.

Habotai silk is a plain-weave fabric woven from continuous, un-spun silk filaments. Unlike plant-derived fibres such as cotton and linen, which consist of short individual staple fibres twisted into yarns, continuous silk filaments have no broken fibre ends along their length. Spun cotton and linen wrappers inevitably shed microscopic short fibres as they rub across grain lines or tacky resin. These loose fibres become permanently embedded in the clear film, scattering light and compromising optical clarity. Continuous-filament silk cannot shed short fibres.

Furthermore, the smooth, cylindrical cross-section of silk filaments produces a dramatically lower coefficient of friction against curing shellac than textured plant fibres. Lower boundary friction reduces surface drag, minimizes heat buildup, and decreases the volume of lubricating oil required on the pad face during polishing passes.

6.5 Selecting Silk Weight (The Momme Calibration) and Textile Desizing

Fabric weight in silk is measured in *momme* (mm), a traditional unit equal to approximately 4.34 grams per square metre. Momme describes the mass per unit area rather than thread count, meaning a higher momme fabric contains thicker filament yarns. Evaluating habotai silk across various weights reveals how yarn geometry dictates fluid transfer rate and mechanical durability.

Lightweight silks, such as 8-momme and 10-momme fabrics, are extremely permeable to spirit varnish, allowing effortless fluid delivery. However, their structural tear resistance is insufficient for bench use;

the fine yarns quickly wear through when passed over sharp edges or open pore structures. Conversely, heavy silks in the 14-momme to 16-momme range are exceptionally durable, but their dense yarn packing acts as an unwanted barrier to fluid transfer. The heavy fabric restricts varnish flow from the core, forcing the maker to squeeze the pad excessively and risk dumping pooled solvent.

A 12-momme habotai silk sits at the exact sweet spot of permeability and durability. It provides a high fluid transfer rate and delicate tactile feedback while maintaining enough structural toughness to endure complete instrument finishing schedules without tearing or fraying.

Textile Preparation and Desizing Rationale

Commercially purchased habotai silk arrives coated with residual starches, waxes, and synthetic chemical sizing agents applied during industrial weaving to protect threads on the loom. While standard textile care instructions strictly warn against hot water processing, using raw silk fresh from the store introduces an invisible hydrophobic barrier that hinders smooth, predictable spirit delivery.

Before cutting wrappers for pad construction, the silk must undergo a thermal desizing preparation. The raw fabric is simmered gently in plain water just below a boil for ten minutes, thoroughly rinsed in warm water to strip all dissolved sizing agents and residual starches, squeezed dry, and allowed to air-dry flat. Removing these manufacturing residues opens the natural silk filaments, dramatically improving capillary wicking, fluid distribution, and tactile feedback across the curing finish.

6.6 Pad Lubricants and Boundary Friction Mechanics

Beyond the smooth nature of desized habotai silk, execution requires a trace amount of external lubricant applied directly to the outer face of the silk wrapper. The lubricant lowers surface friction further, preventing the pad from tearing, dragging, or burning the delicate, curing shellac film as it is deposited. Because this lubricant acts as a dynamic physical boundary during application, its chemical structure dictates both short-term workability and long-term film clarity.

The Non-Polymerization Constraint

The critical chemical prerequisite for any pad lubricant in this system is that it must remain entirely non-drying, non-oxidizing, and unable to polymerize. The lubricant must exist strictly as a loose, migratory fluid on the boundary layer, ensuring it can be safely swept away or "spirited off" with pure alcohol during the final polishing cycles.

If an oil contains drying or semi-drying components—such as walnut oil, olive oil, canola oil, or linseed oil—it introduces two severe failure points. First, within the pad itself, a drying oil will cross-link and harden inside the absorbent cotton and wool core between polishing sessions, turning a carefully shaped fad into a rigid, unusable mass. Second, on the instrument surface, drying oils do not chemically bond to shellac. Instead, as the alcohol evaporates and the resin skins over, migratory droplets of drying oil become mechanically trapped within the solidifying shellac matrix. As that entrained oil slowly oxidizes over subsequent months, it undergoes phase separation, creating microscopic light-scattering voids that manifest as permanent surface cloudiness, blooming, and sticky patches.

Why Jojoba Oil is Uniquely Beneficial

While high-purity light mineral oil (paraffin oil) is a highly stable, completely inert traditional standard that meets these constraints, my current preference is for refined 100% pure jojoba oil. Unlike traditional

plant-derived oils composed of triglycerides, jojoba oil is molecularly a liquid wax ester consisting of long, straight-chain fatty acids and alcohols bound together without a glycerol backbone.

This specific ester geometry gives jojoba immense natural resistance to heat, rancidity, and oxygen breakdown. Under thin-film exposures and standard workshop conditions, it resists polymerization and oxidation entirely. It will never cross-link inside the cotton-wool core, ensuring the fad remains soft and pliable over months of storage. Furthermore, jojoba oil provides exceptionally uniform viscosity and clean boundary slip across the habotai silk face. If trace micro-fractions remain on the shellac surface prior to spiriting off, they behave like an ultra-thin, non-tacky wax interface rather than a sticky oil residue, allowing intermediate level-sanding and scraping to proceed cleanly without gumming abrasives or tracking.

7. Rosinate Anchor Oil (RAO)

7.1 Purpose and Design Philosophy

Rosinate Anchor Oil (RAO) is an oil-dominant wiping varnish developed as a high-performance alternative to traditional shellac, designed with specific attention paid to the acoustic and mechanical behaviour of the finished instrument. The objective of this formulation was not to simplify or shorten the finishing schedule. In bench practice, RAO demands just as much meticulous wood preparation and careful execution as French polishing. Instead, its purpose is to provide a unique combination of physical properties: the forgiving application characteristics of an oil finish, significantly greater surface toughness than shellac, and a highly favourable acoustic profile relative to conventional oil finishes.

These performance characteristics are targeted primarily at instrument surfaces subject to continuous physical contact, such as the back, sides, and neck. The back and sides must withstand constant handling, clothing friction, and incidental wear throughout an instrument's working life. The neck benefits immensely from a durable, non-sticky surface that maintains a smooth, comfortable tactile feel under a performer's hand. RAO provides a balance of surface durability, optical depth, tactile quality, and acoustic transparency. On the neck, where wear resistance and playing friction are paramount, it represents an especially compelling option.

While the formulation is oil-dominant, incorporating glyceryl rosinate sets it apart from conventional oil finishes. The resin contributes structural hardness and high optical refraction, while polymerized tung oil serves as the principal film-forming binder. This combination achieves physical protection without requiring a heavy, damping coating. RAO is applied directly to the casein-sealed wood surface, sharing a vital practical trait with traditional shellac: successive coats actively integrate with the existing finish matrix rather than relying solely on weak mechanical adhesion between separate, isolated layers.

7.2 Formulation and Chemical Interactions

Component	Concentration	Proportional Parts	200.5 g Batch	Primary Function & Physical Role
Glyceryl rosinate	11.5%	100	23.0 g	Resin component; imparts film hardness, scratch resistance, and optical depth.
Polymerized tung oil blend*	45.4%	390	91.0 g	Principal curing oil and film-forming binder.
Gum turpentine	19.5%	167	39.0 g	Solvent; promotes surface wetting, penetration, and initial levelling.
d-Limonene	19.5%	167	39.0 g	Solvent; extends open working window and wipe-back time.
Mineral spirits	3.2%	28	6.5 g	Thinning solvent; fine-tunes fluid handling and viscosity.
Candelilla wax	0.6%	5.6	1.3 g	Hard wax modifier; adjusts tactile feel, gloss, and buffing compliance.
Beeswax	0.3%	2.8	0.7 g	Soft wax modifier; refines surface slip and matting characteristics.
Total	**100.00%**	**860.4**	**200.5 g**	Execute two-stage thermal integration to unite resins and oils safely.

**Note: The polymerized tung oil specified is a pre-mixed commercial 50:50 blend of pure tung oil and mineral spirits. The 390 parts indicated above refer strictly to this pre-supplied commercial blend, not to raw, 100% pure tung oil. Any substitution with pure un-thinned tung oil requires recalculating solvent proportions to maintain proper fluid handling.*

Solvent Balance and Chemical Mechanisms

The solvents are formulated to establish a precise evaporation gradient. Gum turpentine and d-limonene are used in equal proportions by weight but evaporate at markedly different velocities. Gum turpentine drives rapid initial wetting across the cellular structure of the wood, while citrus-derived d-limonene evaporates much more slowly, extending the open working window so the maker can distribute the material extremely thinly before wipe-back. Mineral spirits provide specific solvency to fine-tune fluid handling, ensuring the resin and oil remain perfectly dispersed.

The candelilla and beeswax are present in trace quantities purely to modify tactile feedback and surface matting. Candelilla wax provides a high melting point and tough surface hardness, while beeswax introduces a subtle, non-tacky compliance under hand warmth. Neither wax contributes to film build; rather, they alter the surface energy of the cured film to ensure a smooth, drag-free feel under the player's hand.

7.3 Preparation Protocol

Preparing Rosinate Anchor Oil requires a two-stage thermal integration process to unite the room-temperature resin solution with the warm oil-and-wax blend without causing the waxes or resins to precipitate out of suspension.

The solid glyceryl rosinate is first crushed or ground to maximize its surface area, then added directly to the combined gum turpentine and d-limonene solvents. This mixture is left to dissolve completely at room temperature, which typically occurs overnight without requiring applied heat. In a separate heat-safe vessel, the candelilla wax and beeswax are added directly to the pre-blended polymerized tung oil and heated gently over a flame-free water bath until the waxes melt completely into the oil phase.

Once the oil-and-wax mixture has cooled slightly (remaining fully liquid, warm, and workable) the room-temperature resin solution and remaining mineral spirits are introduced slowly while stirring continuously until the mixture is completely homogeneous. The finished varnish is stored in a tightly closed, clearly labelled container inside a dedicated flammable-liquid safety cabinet. Minor settling of the trace waxes can occur over time, so the container must be shaken or stirred thoroughly prior to each bench use.

7.4 Application Mechanics and Curing Protocols

Because oil-dominant finishes penetrate slightly into the near-surface wood structure, wood preparation must be flawless. Any residual sanding scratches, grain tearing, or uneven surface preparation will remain visible beneath the cured varnish; RAO does not hide underlying defects.

The varnish is applied by wiping a thin, uniform coat onto the casein-sealed surface, allowing it to dwell for approximately five to eight minutes depending on shop temperature and relative humidity. The surface must be monitored closely during this window. As soon as the wet sheen begins to dull slightly, the entire surface must be wiped back thoroughly using clean, lint-free absorbent materials—such as high-quality paper towels or clean shop cloths—removing as much excess liquid as physically possible. The objective is to leave an ultra-thin, continuous boundary layer embedded in the upper pore structure rather than a wet, built-up surface film. If the varnish dwells too long before wipe-back, the polymerizing oil begins to drag, making even removal exceptionally difficult and leaving sticky ridges.

A minimum drying interval of twelve hours must be observed between coats, followed by light surface refinement with ultra-fine abrasives to remove dust nibs before subsequent passes. The twelve-hour interval represents a minimum handling window between applications rather than a full molecular cure. Tung oil cures through auto-oxidation and cross-linking, a chemical process driven by exposure to oxygen, ambient temperature, and ultraviolet light. Passing the instrument through a UV curing cabinet accelerates this cross-linking process significantly, though standard atmospheric curing remains fully effective given sufficient time.

> ▲ **Safety Warning: Spontaneous Combustion Risk.** Rags, paper towels, and applicators saturated with polymerizing oils, such as tung oil or linseed oil, generate exothermic heat as they oxidize. If left crumpled in a pile or trash receptacle, the trapped heat will cause spontaneous ignition. Application materials must never be bundled or left in confined spaces. Immediately after use, lay all saturated towels and cloths completely flat on a non-combustible surface outdoors to dry, or submerge them fully in a water-filled metal container prior to disposal.

7.5 Amalgamation Mechanics and Local Repairability

Rosinate Anchor Oil functions as a true amalgamative wiping finish. When a fresh pass of RAO is applied over a previously cured coat, the active terpene solvents in the new application slightly redissolve and

cut into the upper rosinate matrix of the underlying layer. This allows the new pass to fuse directly into the existing finish structure, forming a continuous, unified film rather than relying strictly on mechanical inter-coat adhesion between isolated layers.

This solvent-mediated integration operates on a mechanism similar to the amalgamation of shellac during French polishing, where fresh ethanol fuses into the underlying spirit film. In bench practice, this amalgamative behaviour provides two major advantages. During intermediate level-sanding, successive applications blend seamlessly without displaying visible witness lines or ringed boundaries between layers. Furthermore, during long-term maintenance or spot touch-ups, fresh varnish blends invisibly into the native finish. Damaged areas on a working instrument can be repaired locally without forcing the maker to strip the entire surface back to bare wood.

7.6 Performance Rationale and Acoustic Optimization

The fundamental purpose of RAO is to provide a durable, ultra-thin finish with a predictable balance of mechanical toughness, optical depth, tactile comfort, and acoustic clarity. In shop practice, it produces a significantly tougher, more moisture-resistant surface than standard shellac, making it particularly well suited for backs, sides, and necks.

Acoustic performance was a central consideration throughout the development of this formulation. Because any finish applied to a tone wood plate adds mass, modifies stiffness, and alters internal damping, oil-based coatings can vary dramatically in their acoustic footprint. Unmodified drying oils often penetrate deeply into the wood tissue, loading the cellular structure down with mass and imposing severe acoustic damping penalties. By pairing a fast-polymerizing tung oil blend with a high-refractive-index hard resin and restricting application to an ultra-thin, aggressively wiped-back boundary layer, RAO avoids these severe damping penalties. It delivers the protective and tactile advantages of a fine wiping oil while maintaining a highly favourable acoustic profile on the finished instrument.

8. Application Workflows and Schedule Execution

8.1 Strategic Sequence and Inter-Layer Mechanics

A finishing schedule is fundamentally a controlled sequence of physical and chemical boundary interactions. Achieving a durable, optically deep, and acoustically transparent finish requires applying each layer in its proper physical state and respecting the necessary cure intervals before introducing the next material. Jumping ahead or rushing solvent evaporation compromises structural adhesion and invites long-term surface defects such as pore sinking, cloudiness, or checking.

The complete schedule integrates every system detailed in the preceding sections into a clear, unified workflow. The process begins with bare wood preparation, proceeds through surface consolidation and pore filling, establishes the optical ground, and concludes with either a traditional spirit varnish padded build or an oil-dominant wiping schedule.

8.2 System A: The Complete French Polishing Schedule

System A represents the classic spirit varnish path, recommended for soundboards and for instruments where maximum repairability, traditional appearance, and optimal acoustic compliance are required. Because open-pored hardwood backs and sides present distinctly different structural demands than delicate softwood soundboards, the preparatory sequences diverge at the bare wood stage before unifying during the padding phase.

8.2.1 Preparatory Sequences: Soundboard vs. Back & Sides

Back and Sides Preparation Protocol

Preparing hardwood backs and sides begins by sanding the raw wood flat to 220 grit using fresh, sharp paper, vacuuming the pore cavities free of dust, and inspecting the surface under raking light. Casein Sealer (Section 2) is applied sparingly across the surface and wiped off immediately using a clean rag to consolidate near-surface cell wall fibres.

Open grain structures are then filled using the dry pumice-and-shellac composite method detailed in Section 3, working the dry aggregate into the pores and activating the shellac binder in situ with pure alcohol. Once the filler has fully set, the surface is dry-sanded flat to 320 grit until the bare wood tissue is completely clean and the filled pores sit flush and dark. The Glyceryl Rosinate Ground (Section 4) is then applied sparingly and wiped back completely, after which the parts are left to dry and cure fully at room temperature for a minimum of 24 hours prior to starting padding sessions.

Soundboard Preparation Protocol

The soundboard is sanded level to 320 grit. Clean water is misted or wiped sparingly across the top to raise loose wood cell fibres, and the surface is left to dry completely before executing a final, light sanding pass to 400 grit. Casein Sealer (Section 2) is applied sparingly across the bare wood and wiped off using a clean rag to consolidate the upper cell wall fibres. The protein layer is left to cure for a minimum of 12 hours. If the water-based casein formulation was selected, raised grain cell ends are lightly knocked down using a white non-woven abrasive pad, exercising care to preserve the thin protein barrier without cutting through to bare wood. The Glyceryl Rosinate Ground (Section 4) is then applied sparingly and wiped back immediately, and the soundboard is left to dry completely for a minimum of 12 hours.

> ▲ **Crucial Boundary Warning:** Do not abrade or sand the soundboard between applying the casein sealer and the glyceryl rosinate ground. Because both preparatory treatments are applied extremely thinly and aggressively wiped back, avoiding intermediate sanding preserves the physical continuity of this foundational boundary layer rather than mechanically interrupting it. If the water-based casein formulation is selected for the top, a gentle scuff with a white non-woven abrasive pad may be used to knock down raised grain fuzz, but the maker must exercise extreme caution not to cut through or interrupt the thin protein wall.

8.2.2 Session Structure and Bodying Cycles

Every individual French polishing session follows a standardized internal fluid progression: the session begins with the 12% heat-processed shellac blend (Section 5) with a trace drop of 100% pure jojoba oil applied to the desized 12-momme habotai silk face (Section 6), and concludes with pure 95%+ ethanol passed over the wet film to level high ridges, clear boundary oil, and amalgamate the freshly deposited resin matrix.

The Four-Session Progression and Flexible Abrasive Refinement

The complete topcoat build is executed across four structured sessions, using specialized flexible abrasives with a relatively dense EVA foam sanding block or a firm felt block to maintain strict surface flatness without rounding over edges or gouging delicate boundaries.

The first and second sessions focus on building initial film depth using continuous figure-eight, straight, and circular padding strokes, finishing each session with pure alcohol. After the second session, the varnish is allowed to flash off and set before flat-sanding the surface lightly using 3M Flexible Abrasive Hand Sheets (270J) at 600 grit, backed with the dense EVA foam or felt block, to level high spots and eliminate minor padding tracks.

The third session follows the exact same fluid sequence, starting with varnish and closing with pure alcohol. Once dry, the surface is flat-sanded using the 3M 270J flexible abrasive sheet stepped up to 1200 grit on the foam or felt block to refine the surface texture without cutting through film thickness.

A fourth and final session is executed to deposit the ultimate micro-layer of shellac, beginning with a dilute 50/50 mixture of the prepared shellac varnish and pure alcohol before transitioning smoothly to straight ethanol to close out the session. The pad is passed across the surface in long, continuous, straight strokes along the grain under minimal hand pressure. The final passes of pure alcohol strip away lingering trace jojoba oil and fuses the uppermost micro-layer of shellac into a glass-like optical finish.

8.3 System B: The Rosinate Anchor Oil (RAO) Schedule

System B is designed specifically for necks, backs, and sides where superior moisture resistance, enhanced scratch toughness, and a smooth tactile feel are prioritized for active performance use. Unlike the spirit-based padding schedule, this oil-dominant workflow relies on ultra-thin boundary wipes, thorough physical removal of excess material, and atmospheric or ultraviolet cross-linking to establish its protective film.

8.3.1 Preparatory Sequences: Back, Sides, and Necks

Preparing wood for Rosinate Anchor Oil begins by sanding the bare wood surface level to 220 grit using fresh, sharp abrasives. Casein Sealer (Section 2) is applied sparingly across the bare wood and wiped off using a clean rag to consolidate the upper cell wall fibres. The protein layer is left to cure for a minimum of 12 hours. If the water-based casein formulation was selected, raised grain cell ends are lightly knocked down using a white non-woven abrasive pad, exercising care to preserve the thin protein barrier without cutting through to bare wood.

8.3.2 Pore Filling and Boundary Preparation

If an ultra-smooth, level pore structure is desired on open-grained hardwood backs and sides, the dry pumice-and-shellac composite protocol (Section 3) is executed directly over the cured casein sealer. Once the composite is activated with pure alcohol and allowed to dry, the surface is sanded level to 320 grit until the wood tissue is clean and the pore cavities sit flush and dark. Alternatively, for a more tactile, open-pore finish—or when finishing necks where a natural wood texture is preferred—this pore-filling step may be omitted entirely, allowing RAO to seat directly inside the natural grain voids.

8.3.3 Varnish Application, Wipe-Back, and Curing Mechanics

A thin, uniform coat of Rosinate Anchor Oil (Section 7) is applied over the prepared surface using a clean shop cloth or high-quality paper towel. The liquid is allowed to dwell for approximately five to eight minutes, depending on ambient shop temperature and relative humidity, until the wet surface sheen dulls slightly. The entire surface is then wiped completely dry using clean, absorbent paper towels or lint-free cloths, removing as much excess material as physically possible. Special attention must be paid to neck heels, rosette rings, and binding ledges to prevent wet varnish from pooling in corners.

The coat is allowed to dry for a minimum of 12 hours under standard shop conditions. Alternatively, the instrument may be placed inside a 365 nm UV cabinet for two to three hours to accelerate the oxidative cross-linking of the tung oil binder. Once cured dry to the touch, the surface may be refined lightly with ultra-fine non-woven abrasive pads or ultra-fine paper to remove dust nibs if desired. This wiping, dwelling, thorough wipe-back, and drying cycle is repeated for three to five total coats until the desired optical depth, surface sheen, and physical protection are achieved.

While a 12-hour interval provides sufficient handling strength between application passes, a critical distinction exists between an inter-coat dry state and a full chemical cure. Because polymerized tung oil cures through progressive auto-oxidation, the completed instrument should rest in a controlled shop environment for 7 to 10 days following the final coat before undertaking final assembly, bridge gluing, or packing for transit. This resting window allows the cross-linked film to reach a suitable physical hardness, chemical resistance, and dimensional stability before being released into service.

8.4 Environmental Bench Control and Curing Conditions

The bench environment exerts a direct influence on liquid drying rates, open working time, and cross-linking mechanics. Ideal shop conditions for both finishing systems are a temperature range of 20°C to 23°C and a relative humidity maintained between 40% and 50%.

If relative humidity exceeds 65%, the rapid evaporation of ethanol during French polishing cools the surface below the local dew point, causing atmospheric moisture to condense inside the wet film and create a permanent milky haze known as *blushing*. Conversely, if humidity falls below 35%, ethanol evaporates too quickly, causing the pad to drag and tear the curing film.

Curing Acceleration vs. Ambient Drying

In my own shop, instruments typically rest inside a dedicated, humidity-controlled UV curing cabinet optimized at a 365 nm wavelength between finishing sessions and coating passes. This specific light spectrum accelerates the auto-oxidative cross-linking of tung oil in the Rosinate Anchor Oil and speeds the complete solvent release of spirit varnish.

However, a UV cabinet is strictly a bench convenience designed to optimize workflow speed—it is by no means a mandatory prerequisite for successfully executing this finishing system. Readers should not view specialized equipment as an impediment to adopting these methods. Without a UV cabinet, both finishing systems cure completely and predictably under standard room ambient light and controlled shop humidity; the material simply requires additional time between passes to reach its full mechanical hardness and working stability.

9. Closing Remarks

The finishing systems detailed in this document reflect an integrated methodology where finishing materials are selected specifically for the distinct mechanical, optical, and protective roles they perform within a larger physical system. A protein-based sealer, a dry particulate pore filler, an esterified resin ground, a heat-cycled shellac spirit varnish, and an oil-dominant wiping varnish each possess fundamentally different properties designed for distinct surfaces of the instrument.

The overriding design aim is not to identify or prescribe a single, universally superior finish. Rather, it is to systematically understand how these disparate components behave, how they interlock at boundary layers, and how their combined structural properties affect the acoustic and structural performance of the completed musical instrument.

These formulations and application procedures will continue to evolve dynamically as further bench experience and testing data accumulate. While several of the practical results are well established within my daily shop workflow, other underlying mechanical explanations remain working hypotheses that would benefit from more rigorous, systematic scientific investigation.

Documenting this workflow is a core component of that continuous research. By making these proprietary formulations, bench procedures, practical observations, and lingering chemical uncertainties completely explicit, I hope to provide other instrument makers with a transparent foundation to evaluate, safely reproduce, adapt, and ultimately improve upon this system.

A Note on Open-Source Lutherie and Community Support

The formulations, processing schedules, and material mechanics detailed within this system represent years of independent research, workshop failures, and chemical refinement. It is a common convention within our craft to treat specialized finishing recipes as proprietary trade secrets—safeguarded to preserve a perceived competitive advantage.

I do not share this philosophy. The advancement of the contemporary acoustic instrument relies entirely on the collective elevation of our community. Gatekeeping technical data only serves to stifle innovation. As such, this manual is, and will remain, entirely free to access, adapt, reproduce, and improve upon.

If you have found this technical system valuable to your own daily shop workflow, I ask that you consider translating that value into a small donation to the Canadian Music Therapy Fund (CMTF). CMTF does vital work across Canada by funding certified music therapists and creating clinical access for vulnerable individuals—including children with neurodivergent needs, adults navigating mental health challenges, and seniors living with dementia. By supporting their programs, we can collectively ensure that the

transformative power of acoustic resonance extends far beyond our workshops and into the lives of those who require it most.

Contributions can be made directly at: **musictherapyfund.ca**